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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/750,986	01/05/2004	Sherman K. Poultney	1857.1580001/DJF/GSB	5464

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EXAMINER	
TURNER, SAMUEL A	
ART UNIT	**PAPER NUMBER**
2877	

DATE MAILED: 02/14/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

BJC

Office Action Summary	Application No.	Applicant(s)	
	10/750,986	POULTNEY, SHERMAN K.	
	Examiner	Art Unit	
	Samuel A. Turner	2877	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *07 November 2005*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-61* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-61* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *05 January 2004* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *9/29/04, 11/7/05*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 15 and 40 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

With regard to claims 15 and 40, these claims conflict with apparatus claims 1 or 27 respectively. Claims 1 and 27 require the first grating. Claims 15 and 40 replace the first grating with a third grating. This does not limit the invention as claimed in claims 1 and 27. Claiming a substrate having at least a first grating in claims 1 and 27, then adding the third grating to the substrate in claims 15 and 40 would overcome this conflict.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-4, 7-11, 14-16, 22-30, 34-36, 39-41, 48, 50, 52, 53, and 59-61 are rejected under 35 U.S.C. 102(b) as being clearly anticipated by Baselmans et al (2002/0145717).

Fig.1.

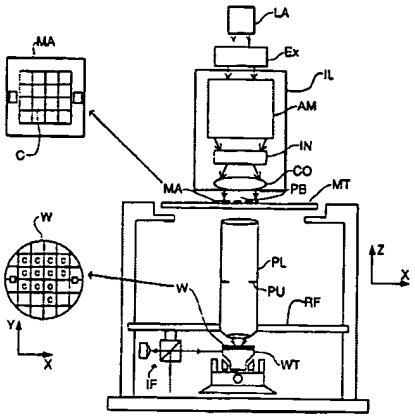


Fig.2.

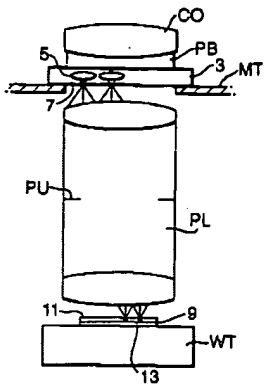


Fig.3B.

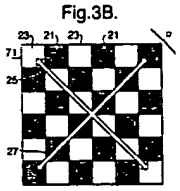
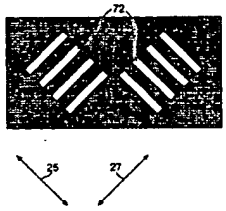


Fig.3C.



With regard to claim 1, Baselmans et al teach a wavefront measurement system comprising:

a source of electromagnetic radiation(LA);

an illumination system that directs the electromagnetic radiation uniformly at an object plane(IL);

a first grating positioned in the object plane that conditions the electromagnetic radiation(7);

a projection optical system that projects an image of the first grating onto a focal plane(PL);

a second grating at the focal plane(11; paragraph [0101]); and

a detector behind the second grating that receives a fringe pattern produced by the second grating(13).

Note: in paragraph [0101] Baselmans et al specifically describe the pinhole 11 as having the form of the structure shown in figure 3b which is a grating structure.

As to claim 2, wherein the second grating is a two-dimensional grating(11; paragraph [0101]).

As to claim 3, wherein the two-dimensional grating is a checkerboard grating(11; paragraph [0101]).

As to claim 4, wherein the two-dimensional grating is a cross-grating(7; paragraph [0081]; paragraph [0101]; Fig. 3b).

As to claim 7, wherein the source is an Extreme Ultraviolet (EUV) radiation source(LA; paragraph [0066]).

As to claim 8, wherein the source is a 13.5 nm radiation source(LA; paragraph [0048]).

As to claim 9, wherein the first grating is mounted on a reticle stage(MT).

As to claim 10, wherein the second grating is mounted on a wafer stage(WT).

As to claim 11, wherein the first grating is oriented at 45 degrees relative to the second grating(7; paragraph [0101]; Fig. 3c).

As to claim 14, wherein the first grating is a linear grating(7; paragraph [0101]; Fig. 3c).

As to claim 15, further including a third grating oriented orthogonally to the first grating and positionable in the object plane in place of the first grating(7; paragraph [0101]; Fig. 3c).

As to claim 16, wherein the detector is a charge coupled device (CCD) detector(13; paragraph [0087]).

As to claim 22, wherein a pitch of the first grating is such that a second order diffraction pattern disappears at the focal plane(7; paragraph [0079]).

As to claim 23, wherein the detector receives a 0th order diffraction image of a pupil of the projection optical system and +/-1st order diffraction images of the pupil of the projection optical system(7; paragraph [0079]; paragraph [0085]).

As to claim 24, wherein the first grating fills an input numerical aperture of the projection optical system(7; Fig. 2).

As to claim 25, wherein the first grating smoothes illumination irregularities of an input pupil of the projection optical system(IL; paragraph [0071]).

As to claim 26, wherein the first grating maximizes electromagnetic radiation incident onto the projection optical system that can form fringes in a fringe plane(IL; paragraph [0071]).

With regard to claim 27, Baselmans et al teach a wavefront measurement system comprising:

a source of electromagnetic radiation(LA);

an imaging system that focuses the electromagnetic radiation at an object plane(IL);

a first grating positioned on a reticle stage that generates a diffraction pattern at a focal plane(7);

a projection optical system that projects an image of the first grating onto the focal plane(PL);

a second grating positioned on a wafer stage that receives a diffracted image of the first grating(11; paragraph [0101]); and

a detector positioned on the wafer stage in the focal plane that receives the image of a pupil of the projection optical system through the second grating(13).

As to claim 28, wherein the second grating is a two-dimensional grating(11; paragraph [0101]).

As to claim 29, wherein the two-dimensional grating is a checkerboard grating(11; paragraph [0101]).

As to claim 30, wherein the two-dimensional grating is a cross-grating(7; paragraph [0081]; [0101]; Fig. 3b).

As to claim 34, wherein the source is an Extreme Ultraviolet (EUV) radiation source(LA; paragraph [0066]).

As to claim 35, wherein the source is a 13.5 nm radiation source(LA; paragraph [0048]).

As to claim 36, wherein the first grating is oriented at 45 degrees relative to the second grating(7; **paragraph [0101]; Fig. 3c**).

As to claim 39. The system of claim 27, wherein the first grating is a linear grating(7; **paragraph [0101]; Fig. 3c**).

As to claim 40, further including a third grating on the reticle stage, the third grating being oriented orthogonally to the first grating and positionable in an optical path in place of the first grating(7; **paragraph [0101]; Fig. 3c**).

As to claim 41, wherein the detector is a CCD detector(**13; paragraph [0087]**).

As to claim 48, wherein a duty cycle of the first grating is such that a second order diffraction pattern of the source disappears at the focal plane(7; **paragraph [0079]**).

As to claim 50, wherein a duty cycle of the second grating is such that a second order diffraction pattern from the second grating disappears at a fringe plane(7; **paragraph [0079]; paragraph [0085]**).

As to claim 52, wherein the detector receives a 0th order diffraction image of an output pupil of the projection optical system and +/-1st order diffraction images of the output pupil of the projection optical system(7; **paragraph [0079]**).

As to claim 53, wherein the second grating forms a shearing interferometer (11; **paragraph [0101]**).

As to claim 59, wherein a magnification of the projection optical system is approximately 4X(**paragraph [0075]**).

With regard to claim 60, Baselmans et al teach a system for EUV photolithography comprising:

an EUV source emitting EUV radiation(LA);

an imaging system that uniformly illuminates an object plane with the EUV radiation(IL);

a reticle stage for mounting a reticle in an object plane(MT);

a first grating positioned on a reticle stage that generates a diffraction pattern at a focal plane(7);

a projection optical system that optically conjugates the focal plane and the object plane(PL);

a wafer stage(WT);

a second grating in the focal plane and positioned on the wafer stage(11; **paragraph [0101]**); and

a detector positioned on the wafer stage that receives multiple images of a pupil of the projection optical system through the second grating(13).

With regard to claim 61, Baselmans et al teach a method of measuring a wavefront of an optical system comprising:

generating electromagnetic radiation at a source(LA; **paragraph [0070]**);

directing the electromagnetic radiation at an object plane of the optical system(IL; **paragraph [0070]**);

positioning a first grating in an optical path of the optical system that generates conditioning a diffraction pattern at a focal plane of the optical system(7,MT; **paragraph [0077]; paragraph [0101]**);

conjugating the focal plane and the object plane(PL; **paragraph [0069]**);

positioning a detector below the focal plane and a second grating at the focal plane(11,13; **paragraph [0101]**; Fig. 3b);

receiving multiple images of a pupil of the projection optical system through the second grating(**paragraph [0101]**); and

calculating wavefront parameters from the image(**paragraph [0101]**).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 5, 6, 13, 17-21, 31-33, 38, 42-47, 49, 51, and 54-58 are rejected under 35 U.S.C. 103(a) as being unpatentable over Baselmans et al (2002/0145717).

With regard to claims 5 and 31, Baselmans et al teach That while the system is disclosed as a transmission system a reflection system can also be used. It would have been obvious to one of ordinary skill in the art at the time the invention was

made that if the system is reflective then the gratings must also be reflective. This is due the use of an EUV light wherein mirrors and reflective masks are used instead of transmission optics.

With regard to claims 6 and 32; Baselmans et al teach wherein the gratings can be transmission, phase, or reflectance. It would have been obvious to one of ordinary skill in the art at the time the invention was made to chose the grating dependent on the illuminating source, either transmission, phase, or reflectance.

Baselmans et al fails to teach the details of the specific grating construction. Official notice is taken that silicon , silicon nitride, and quartz are well know grating substrates. Further, for gratings in EUV systems nickel is a well material. See In re Malcom, 1942 C.D 589; 543 O.G. 440.

> If applicant does not traverse the examiner's assertion of official notice or applicant's traverse is not adequate, the next Office action will indicate that the common knowledge or well-known in the art statement is taken to be admitted prior art because applicant either failed to traverse the examiner's assertion of official notice or that the traverse was inadequate.

With regard to claims 21, 33, 46, and 47; it would have been obvious to one of ordinary skill in the art at the time the invention was made form the gratings out of metal, specifically nickel, dependent on the source. For EUV sources, reflection optics, and reflection gratings made of metal are needed because of the effects of EUV on transmission optics.

With regard to claims 17-20, and 42-45; it would have been obvious to one of ordinary skill in the art at the time the invention was made form the gratings on

any well known substrate, dependent on the source. For EUV sources, reflection optics, and gratings are needed because of the effects of EUV on transmission optics.

With regard to claims 13 and 38, Baselmans et al teach that when the second grating has a checkerboard configuration(figure 3b) the first grating either one of two orthogonal configurations(figure 3c) thus aberrations can be measured in two directions. It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the Baselmans apparatus by using cross-gratings or a checkerboard grating instead of the figure 3c configuration so that two directional aberrations can be measured simultaneously.

With regard to claims 49, 51, and 54-56; Baselmans et al fails to teach the specifics of the gratings used, including duty cycle, pitch, or shearing ratio. It would have been obvious to one of ordinary skill in the art at the time the invention was made to select the gratings parameters which provide the best detector signals to measure the projection optics aberrations, since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

With regard to claims 57 and 58, baselmans et al fails to teach the N.A. of the projection optics PL. It would have been obvious to one of ordinary skill in the art at the time the invention was made to apply the teachings of Baselmans to any

projection optical system. The N.A. is based on the exposure system and would not effect the operation of the aberration testing.

Claims 12 and 37 are rejected under 35 U.S.C. 103(a) as being unpatentable over Baselmans et al (2002/0145717) in view of Wegmann et al (2002/0001088).

Baselmans et al fails to teach relating the first(7) and second(11) gratings by pitch and magnification. Wegmann et al teach that when testing projection optics the first grating 7 is matched to the second grating 11so that only certain diffraction orders contribute to the interference pattern, see paragraph [0095].

It would have been obvious to one of ordinary skill in the art at the time the invention was made match the first and second gratings in the Baselmans apparatus such that only certain diffraction orders contribute to the interference pattern. This is obvious when one considers that the first grating represents the reticle or mask in the lithographic system and the second grating represents the wafer on which a greatly reduced pattern of the reticle is to be printed. In the case of Baselmans, the magnification between the first and second gratings would be M=1/4 to 1/5 and the pitches must be matched such that only selected orders interfere.

Relevant Prior Art

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Lee(4,707,137), Ichihara(6,312,373), and Goldberg et al(6,573,997) are cited as other examples of lens testing.

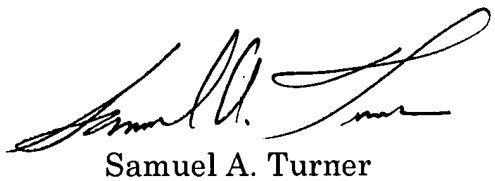
Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Samuel A. Turner whose phone number is 571-272-2432.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Gregory J. Toatley, Jr., can be reached on 571-272-2800 ext. 77.

The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see **http://pair-direct.uspto.gov**. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



Samuel A. Turner
Primary Examiner
Art Unit 2877